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ABSTRACT

This study conceptualized school-based computer coordinators as change agents and analyzed their strategies, skills, and outcomes. Questionnaires and interviews were used to gather data from three computer coordinators, their supervisors, teachers, and parents. Data were analyzed case by case and then across cases, using the framework and method of data analysis developed by Matthew Miles. Results revealed that: (1) impediments to the integration of computers into the curriculum include lack of budgetary support, demands on teachers, negative experiences with previous innovations, and competing demands of other school improvement programs; (2) coordinators facilitate computer use through a combination of product- and client-centered strategies which include resource-adding, training of teachers, providing technical assistance, organizing the school's instructional computing program, energizing and motivating the client, and collaborative problem solving; (3) effective coordinators must have technical expertise as well as interpersonal skills; (4) outcomes resulting from the computer coordinator's work include improved teacher skills, implementation of school goals, teacher satisfaction, and greater student comfort with computers. Guidelines for the implementation of the coordinator role are suggested, and several directions for future research are recommended. (25 references) (Author/MES)

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SUCCESSFUL CHANGE AGENT STRATEGIES FOR OVERCOMING IMPEDIMENTS TO MICROCOMPUTER IMPLEMENTATION IN THE CLASSROOM

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ABSTRACT

School districts are committing large amounts of money to teacher training, equipment, and instructional materials in the hope that implementation of instructional computing will occur. One approach to teacher training and support has been to create a new role: the school-based computer coordinator. The present study conceptualized these coordinators as change agents and analyzed their strategies, skills, and achieved outcomes.

Questionnaires and interviews were used to gather data from three computer coordinators, their supervisors, teachers, and parents. The data were analyzed case by case, and then across cases, using the framework and method of qualitative data analysis developed by Matthew Miles.

The study revealed that school-based computer coordinators use a combination of product- and client-centered strategies to facilitate computer use. These strategies include training of teachers, providing technical assistance, organizing the school's instructional computing program, and supporting and energizing the client. Effective strategies take into account the "plight" of classroom teachers who appear burdened by existing teaching and planning responsibilities. Coordinators decrease teacher resistance by supplying materials and ideas, "pre-booting" labs, organizing parent support, and assisting with custodial chores. They also employ the strategy of gradually "weaning" teachers of their dependence on the coordinator.

The findings suggest that while effective coordinators must be knowledgeable about instructional computing, it is just as critical that they possess strong interpersonal and organizational skills to carry out necessary training and support functions. These skills include initiative-taking and tenacity to secure resources and "keep the program going." An unexpectedly important skill involves facilitating group functioning and decision-making.

Outcomes effected by the computer coordinators include improved teacher skills and readiness for further growth, implementation of school goals, teacher satisfaction with the program and increased feelings of self-esteem and professional growth, and greater student comfort with computers.

The present study identified many impediments to implementing computer-based innovations and documented coordinators' strategies and skills for overcoming these impediments. The findings of the present study are generally consistent with previous research findings on the characteristics of other types of effective change agents. The present study therefore supports the effectiveness of staffing computer coordinators as change agents at the school level.

Paper presented at the annual meeting of the American Educational Research Association
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INTRODUCTION

Purpose of the Study

The Rand Change Agent Study (Berman & McLaughlin, 1977) found that even the best innovation could not succeed with inadequately trained or uncommitted teachers. Staff development, therefore, is critical for the implementation of new programs and teaching methods. One element of effective staff development is support following initial training (Gall & Renchler, 1985). Follow-up support helps teachers to transfer newly learned teaching skills and practices into their active teaching repertoire (Joyce & Showers, 1983). The present study focused on the computer coordinator's role in facilitating the transfer of teacher training with regard to instructional computing. Specifically, the purpose of this study was to examine the role of school-based computer coordinators as change agents in elementary school programs.

A growing number of people hold the position of instructional computer coordinator at the school level (Barbour, 1986; Moursund, 1985). A recent survey in Electronic Learning (Barbour, 1986) yielded the following findings regarding school-based computer coordinators:

1. Job descriptions vary greatly.

2. Only 21 percent of the respondents actually hold the title "computer coordinator"; the other 79 percent function in that role on a de facto basis.

3. Eighty percent of school computer coordinators who responded fulfill their role as an additional responsibility; of the remaining 20 percent, only 4 percent fulfill their role on a full-time basis, while 16 percent function on a part-time or "released" basis.

In a follow-up survey in Electronic Learning, McGinty (1987) reported that 33 percent of the school level coordinators are now functioning in that role on a full-time basis. McGinty maintains that this shift seems to involve a redefinition of computer coordinators' jobs, and he characterizes this shift as the biggest change in the profession over the past year. McGinty stated that job descriptions of school-level coordinators still vary greatly. The 1987 survey yielded the following:

1. Over 90 percent of the school-level coordinators are responsible for teaching students.

2. Over 80 percent are responsible for evaluating software and making recommendations for purchase.

3. Over 70 percent are responsible for evaluating and recommending hardware, maintaining the school's equipment, purchasing software, training other teachers, and teaching programming to students.

The present study attempted to provide a detailed description of the computer coordinator's role. It focused on the emerging group of coordinators who have been provided released time to facilitate computer implementation in the schools.

A recent study of school improvement found that the successful implementation of innovative programs is dependent upon the intervention of key personnel involved in various change agent roles (Huberman & Crandall, 1982). A change agent is defined as an assistance person whose role includes responsibility for initiating or facilitating change. In the present study, school computer coordinators were conceptualized as this type of change agent, hired on a part-time basis to provide a variety of services on a school level.

This emerging role is being given increased attention because of a shift in the approach to school improvement. Whereas the post-Sputnik school reform campaign tended to rely on centralized curriculum changes, current efforts focus on school-based change. With this change there has been a corresponding shift in change agent roles from disseminator of curriculum ideas and materials to process consultant or trainer (Beaton, 1985). Whereas the former role emphasized implementing change through the spread of "packaged" programs, the latter role involves attending to the process and training needs of local school personnel.

While change agents are widely used in current school improvement programs, little is known about their functions, the strategies they employ, the specific skills most crucial for their success, or how to train for such skills (Fullan, 1981; Louis, 1981; Miles et al., 1986a). The Patterns of Successful Assistance study (Miles et al., 1986a) focused on these concerns in its two-year investigation of 17 change agents working in three urban school improvement programs. Miles (1984) developed a list of strategies that change agents use, skills they need, and outcomes they intend to effect. Lists of strategies, skills, and outcomes, shown in Appendix A, were adapted from Miles' work and used in the present study to investigate the role of computer coordinators.

Research Questions

This study investigated the activities of school-based computer coordinators in their effort to facilitate change in their schools. In particular, it set out to answer the following questions:

1. What is the situational and historical context in which computer coordinators do their work?
2. What is the range of strategies used by computer coordinators?
3. What skills do they need in that role?
4. What are the intended and actual accomplishments resulting from the computer coordinators's work?

In the process of analyzing the data, we became increasingly aware that the coordinators continually faced obstacles to implementing their program. We conceptualized these obstacles as "impediments." The data were analyzed to determine specific impediments. The results of this analysis are presented following Research Question #1, since these results help in interpreting the findings relating to the other research questions.

METHOD

Research Design. Questionnaire, interview, and observation procedures were used in this exploratory case study of three school-level computer coordinators carrying out a change agent role. The data were gathered from multiple sources. Responses of the coordinators to particular questions were checked against responses to similar questions by other informants, namely, their supervisors (principals and the district computer coordinator) and clients (the teachers and parents in their school). Observation of representative activities and examination of relevant documents provided an additional check on the validity of the coordinators' responses.

Sample. In 1984, the District 4J Computer Council recognized the need for a uniform approach to computer education at the elementary level. In June of that year, a group of teachers, under the direction of the District Computer Coordinator, began developing a program that would focus on integrating the computer into the established curriculum and on providing articulation between grade levels. The program was piloted during the 1984-85 school year. The pilot study was evaluated (Ames, Gilberstad, Sky and Strudler, 1985), and

the program was deemed feasible contingent upon continued district support for computer resources and staff development. The evaluators recommended that part-time "computer persons" be designated to coordinate training, maintenance, and scheduling at the school level.

During the 1984-85 school year, only one of Eugene's 24 elementary schools employed a released-time computer coordinator (defined as any coordinator who is assigned .10 FTE (full time equivalent) or greater for computer-related responsibilities). By the following school year, nine elementary schools had opted for released coordinators. The present study examined the situational and historical reasons for this trend.

At the time this study was conducted, Eugene School District 4J had nine elementary schools with released-time computer coordinators. A sample of three of these schools was selected for this study because their coordinators were identified as having brought about a high degree of implementation of instructional computing. The identification process involved consulting with the district computer coordinator, the district evaluation specialist, and the Educational Service District curriculum/staff development specialist, and by personal observations of computer implementation in the schools. Additionally, consideration was given to choosing coordinators who vary with regard to critical variables, namely: (1) technical expertise in computing, (2) role expectations of computer coordinators by supervisors, teachers, and themselves, (3) previous teaching experience in the particular school, and (4) available resources. In this report, the three coordinators are designated as Tom at East School, Sue at Central School, and Karen at West School.

Data Collection Instruments. Semi-structured interviews and a questionnaire were adapted from those used in the studies of school improvement coordinators by Miles and colleagues (1986a) and of staff development specialists by Beaton (1985). A form of the questionnaire was given to each coordinator to assess his or her strategies and skills, and achieved outcomes. Another questionnaire, almost identical, asked each supervisor to prepare a similar profile of each coordinator.

Four interview schedules pertaining to the role and qualities of the computer coordinators were administered. Informants included the coordinators (interviewed twice), their supervisors (principals, district administrators), and their clients (teachers and parents). Fifty-two interviews were conducted, ranging from twenty-five minutes to more than two hours in length. Further data were gathered by direct observation of instruction and staff meetings and by analysis of planning documents.

The data were collected over a ten-week period of time.

Data Analysis. All 52 interviews were tape-recorded, and selected segments were transcribed. Field notes and interview data were coded for analysis according to the list of variables adapted from Miles (see Appendix A). A second coder was employed and the coding of skills and outcomes was checked for inter-rater reliability. Addenda to the initial coding definitions were created and codes were modified until a reliability rating of 87 percent was achieved for both variables (skills and outcomes), coded together. Strategies were not tested for coding reliability. Rather, strategies were treated as a high inference variable, allowing greater latitude for interpretation by the author.

RESULTS

A summary of results is presented in this section, organized by research question. See Strudler (1987) for a detailed description of each of the three cases examined.

1. What is the situational and historical context in which computer coordinators do their work?

Each of the three schools examined in the present study has had similar patterns in the expansion of their computer education programs. The growth can be characterized as a "bottom-up" movement in which a few interested teachers led the way, supported by parents and building administrators. Some monies were allocated at the school level for the purchase of computer hardware and software, but additional fund-raising campaigns were instrumental to the growth of the programs. The district encouraged expanded computer use and eventually recognized the need to coordinate this growth. It created a district-level coordinator position and from the central office it sought to facilitate the proliferation of computers. Overall, the schools experienced a "bottom-up" groundswell that was supported at the top level by district officials.

1a. What are the impediments to the integration of computers into the curriculum?

Despite the groundswell of enthusiasm for computer use in schools, there are a number of impediments to integrating this technology into the curriculum. In order to be effective, coordinators must apply specific strategies and skills to overcome such obstacles. The following discussion of impediments, therefore, is offered to help explain the strategies and skills that were examined in this study.

While the district is supportive of the goals of computer integration, many informants cited the district's lack of additional budgetary support to implement the innovation. Individual schools that are interested in expanding their computer use must rely largely on existing district allocations for staff development and support personnel. Schools wanting a released computer coordinator must "find the tenths" necessary to staff the position. While district funds have been budgeted for hardware and software, many school-level personnel consider the funding to be inadequate for computers to have a significant impact on school programs.

As described in the three cases, teachers embraced the challenge of increased computer use with varying attitudes. Within the range of reactions, however, there are a few recurring themes which involve impediments to computer integration. First, teachers expressed feeling burdened with their present teaching and planning responsibilities. Many teachers alluded to having to work an ever-expanding curriculum into their school day. Therefore, even teachers who are comfortable with the new technology are concerned about having new demands placed on their time and energy. For those who are not comfortable, the resistance to "one more thing" tends to be that much greater.

The phrase "add-on" was often used to describe how many teachers viewed current plans for classroom teachers to integrate computers. While most accepted the concept of integration in theory, the current realities (the "fit" of existing software into the curriculum, limited resources, teachers' lack of familiarity and comfort with the technology, etc.) contribute to what many teachers view as a "computer-expanded" curriculum. They explained that the added computer-based curriculum only partially supplants what is being taught in the existing curriculum. The rest, they maintain, is an "add-on." Many teachers do not see how current computer-based curriculum materials and the plans for implementation will enable them to teach more, better, or faster. In short, many do not see how computers will help them to do their job better.

Teachers' previous experience with other educational innovations impose further obstacles toward their present computer use. The more the participants have had negative experiences with previous innovations, the more cynical or apathetic they tend to be regarding current change efforts (Fullan, 1982). For some teachers, the buzz-word "integration" triggers a negative reaction. One teacher articulated this skeptical position: "They always want to justify everything by integrating it into the total curriculum. I mean, that's the way they do everything, and I've taught for 28 years." The teacher added, "No matter what the theory is and how idealistic it may sound, it's [educational computing] just an add-on."

Also, teachers mentioned the competing demands of other school improvement programs. While computer education was given top priority at some point in each of the schools, many teachers cited being involved in programs aimed at other aspects of their professional growth (e.g., teaching strategies, ITIP, working with "at-risk" students). In addition, all of these improvement efforts must compete with the "ordinary demands of keeping school running" (Miles et al., 1985).

While teachers involved in the present study supported expanded computer use in their schools, some were not convinced that computers should be integrated by all classroom teachers. Many teachers preferred hiring a computer specialist who would be responsible for teaching computer-related topics to students, much as art and music specialists do in their respective areas. Proponents of this approach were resistant to the expectation that all teachers acquire the expertise necessary to teach with computers.

2. What is the range of strategies used by computer coordinators?

The strategies that the coordinators gradually evolved can be viewed as efforts to overcome the existing impediments that inhibit implementation. Also, implicit in these strategies is the assumption that a majority of teachers are open to greater computer use, but not truly committed to the innovation. Figure 1 illustrates the spectrum of teachers' attitudes toward using computers. The model, which was suggested by John (the district coordinator), uses his estimated percentages. Depicted on the left side are the truly resistant teachers who want nothing to do with computers. On the far right are the "computer zealots," teachers who will figure out ways to teach with computers despite existing obstacles. The majority of the teachers, however, remain in the middle group: those open, but not truly committed to increased computer use.

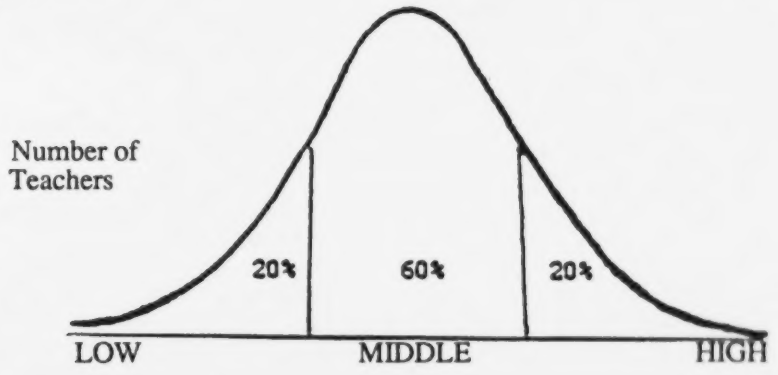

FIGURE 1. Estimated distribution of teachers' attitudes and commitment toward using computers in schools.

The three coordinators in the present study use a variety of common strategies that help overcome the impediments to increased computer use and facilitate teachers' movement to the right (in Figure 1), toward greater comfort and commitment. The key strategies discussed in this section are organized into four clusters: (1) resource-adding, (2) organizing and preparing, (3)training, and (4) collaborative problem solving.

Resource-adding addresses a major impediment to implementation-- insufficient computer resources. This strategy is critical due to the need to supplement district funding for computer hardware and software. While this strategy is used in the work of other change agents (Beaton, 1985; Miles et al., 1986a), it appears especially critical for computer coordinators. Coordinators pursue this strategy by seeking grants from outside sources and soliciting monies from their school's budget for equipment, software, and staff development. Successful resource-adding does a great deal to enhance the program's credibility with teachers. They are much more resistant to allocating instructional time to computer-based activities if the quantities of hardware and software are inadequate to meet the needs of their students. Also, successful resource-adding contributes to the credibility of the coordinator with teachers. And as Rogers (1983) found, credibility is positively associated with change agent success.

Organizing and Preparing is a productive response to the "plight" of elementary teachers who are overloaded with the demands of a crowded curriculum. Effective coordinators perform a variety of functions that help to overcome this impediment. Where possible, they avoid placing further burdens on already busy teachers. Coordinators help by: (1) organizing and scheduling the lab, (2) screening for software that meets the needs of students and teachers, (3) having computer labs "pre-booted" and ready for student use, and (4) assisting with custodial chores. Teachers seem much less resistant to using computers in the curriculum if instructional time with students is maximized and teacher preparation time is minimized.

Coordinators can facilitate some support functions by organizing parent volunteers to help in the lab. When done effectively, this tactic provides teachers with much needed assistance.

Training of groups is an important strategy for increasing teachers' facility and confidence with computers, and ultimately their commitment to integration. Training helps to move teachers through an awkward transitional learning period to the stage where they view computers as another professional tool. Upon beginning implementation of an innovation, teachers are initially concerned about how it will affect them personally (Hall, 1976). Will they feel incompetent in trying to teach with computers? Does the integration of computers into the curriculum threaten their self-concepts as professionals? Effective training helps to overcome such concerns that serve as impediments to implementation of the innovation.

A subsequent level of teacher concern involves how the innovation will impact students (Hall, 1976). This explains teachers' preference for training sessions targeted for teachers of specific grade-level or interest areas. This approach appeals to the teachers' "practicality ethic," that is, their belief that new practices and methods should be practical in meeting the needs of their students (Doyle & Ponder, 1978). Teachers also stated a preference for friendly, but structured sessions that consist of brief demonstrations and ample time for practice.

Although none of the coordinators employed a formal coaching component, their training program was based upon being available to provide follow-up support on an individual basis. While much of the support involved giving technical assistance, all three coordinators used strategies that provided for the affective needs of their clients. All coordinators were non-evaluative and non-judgmental, and supportive emotionally--approaches that contribute to the building of trust and rapport. Previous studies of effective change agents (Beaton, 1985;

Miles et al., 1986a; Miles et al., 1986b) confirm the importance of providing non-judgmental support to establish a safe environment that facilitates change and growth.

Energizing and motivating the client appear critical to the training process. As was previously emphasized, teachers have a great many demands placed upon them, and they often need a "pat on the back" or an "encouraging word" to get them to cope with a stressful learning situation. Demonstrating and modeling serves to energize and motivate teachers. By being in a position to observe effective teaching with computers, teachers become encouraged that they can do it, too.

Collaborative problem solving is a noteworthy strategy that helps teachers and the coordinator to integrate the new technology into the school program. Similar to other change agents (Beaton, 1985; Miles et al., 1986a; Miles et al., 1986b), computer coordinators work collaboratively with individual teachers to effect change in the content and delivery of instruction. In addition, however, successful coordinators work collaboratively with small groups of teachers (usually grouped by grade level) and their school's policy-making body--the computer committee. This strategy of collaboration appears especially important for establishing teacher ownership of the program. Teachers emphasized that effective coordinators listen to what they have to say and involve them in making decisions about the program. Teachers expressed being less resistant to change when they can influence the "fit" between their other curricular responsibilities and the computer program. This is consistent with the findings of the Rand Study (Berman and McLaughlin, 1978), which suggested that involving teachers facilitates commitment as well as more informed decision-making.

Coordinators enhance the strategy of collaboration by emphasizing their homophyly (similarities of beliefs, experience, etc;) with clients (Louis, 1981; Rogers and Shoemaker, 1971). They tend to play down their computer expertise and resist being called "the expert." Rather, they prefer to be seen as "just another teacher who knows something about using computers in schools." While teachers may welcome the advice of experts, many are resistant to an expert "coming in and telling them how to teach." Perhaps this resistance is due to the great discrepancies that exist between "ivory tower" theories of education and the many impediments that make it difficult to translate those theories into daily practice. At any rate, by collaborating and de-emphasizing their expertise, coordinators seek to minimize teacher resistance.

3. What skills do computer coordinators need in that role?

Skills are the tools with which coordinators carry out their strategies for expanding computer use. While various strategies are critical for overcoming impediments to implementation of instructional computing, coordinator skills are needed to actually facilitate change. A description of each skill, as used by each coordinator, is presented in the case studies (Strudler, 1987). In this section, we will offer a brief overview of the skills used across the three cases and highlight a few key points.

The findings suggest that while effective coordinators must be knowledgeable about instructional computing, it is just as critical that they possess strong interpersonal and organizational skills to carry out necessary training and support functions. Nearly all informants expressed that interpersonal skills for coordinators are more important than their knowledge of computing. Like any good teacher, coordinators rely on interpersonal skills to convey the "subject matter" in a clear and patient manner, and to motivate people to learn. Teachers appear especially resistant to "computer experts" who "know, but can't teach." Of course, coordinators who are truly effective are strong in both areas of expertise. The need for coordinators to possess a combination of interpersonal and technical skills is consistent with findings regarding other change agents (Beaton, 1985; Miles et al., 1986a, 1986b; Rogers, 1983).

Table 1 provides a summary of five different approaches to quantifying skills used by coordinators. The number in each column represents the percentage of mentions of each skill out of the total for that approach (column). For example, the second column consists of the total mentions of a particular skill throughout all of the interviews across the three cases. Technical expertise, then, comprised 11.3 percent of all skills mentioned throughout the interviews. The actual frequency was 63, and the total mention of all skills coded was 556. The percent derived is therefore 63/556, or 11.3 percent.

Percentages were used to assign an equal weight to each skill category and thereby standardize the reporting. Also, using percentages allowed for a straightforward way to compute an average score (in the last column).

The third column represents the percentage of responses to interview questions asking about the coordinator's strengths or main contributions to the program (out of the total responses citing strengths or main contributions). The fourth column lists percentages of skills mentioned as being involved in critical incidents, that is, incidents in which the coordinator was identified as being especially helpful. The fifth column lists how supervisors and coordinators ranked the importance of various skills on their questionnaires. The percentage given was derived by weighting informants' responses and then computing a total. The higher the percentage, the higher the average rank of that skill.

The sixth column lists the percentage of times that each skill was recommended by informants as critical for selecting school computer coordinators. The final column shows the average percentage derived from the adjacent five columns. Skills are listed by the total average, from highest to lowest.

Readers should be cautioned about placing too much emphasis on the summary statistics. They were provided to supplement, not substitute for, the detailed descriptions of skills in the case studies (Strudler, 1987). In presenting findings for their research project, Miles and his colleagues offered similar warnings. They stressed, "The important thing is to draw clear meaning from the three cases, in answer to our research questions" (Miles et al., 1986b). When viewed in perspective, the data in Table 1 are a useful supplement to the descriptions of skills and offer a framework for discussion.

Readers also should resist the convenience of merely referring to the composite average column. Much meaning can be derived by analyzing disparities in the various columns. For example, while group functioning is listed in the bottom third of the skills, it received a high rating on the questionnaire and very low ratings in the other categories. The questionnaire, it should be noted, was completed only by supervisors and coordinators. Thus, the imbalance in scores reflects the fact that while teachers are not aware of the value of this skill, coordinators and supervisors are.

Technical Expertise was cited as the single most important skill used by coordinators. If various interpersonal skills were grouped together, however, the interpersonal skills cluster would rank at the top of the list of skills. It should be stressed that technical expertise was defined in this study as "knowledge of hardware and software involved in instructional computing." As one principal commented, "You [coordinators] don't have to know how to change circuit boards and know all the 'ins and outs' of the insides of computers...." John confirmed that a coordinator does not need an extensive background in academic computer science.

Table 1. Percentage of Times That Each Change Agent Skill Was Mentioned in Interviews

Change Agent Skill	Total Mentioned	Strength Contrib	Critical Incident	Quest Rankings	Recs for Selection	Total Average
Technical Expertise	11.3	9.6	21.2	7.3	23.4	14.6
Admin/Organization	10.3	14.4	3.8	3.8	13.8	9.2
Providing Support	10.1	8.7	17.5	6.7	1.1	8.8
Resource Bringing	7.4	8.7	11.2	4.3	2.1	6.7
Collaboration	8.3	3.8	11.2	2.2	7.4	6.6
Training/Doing Workshops	7.4	8.7	7.5	5.4	3.2	6.4
Interpersonal Ease	4.5	4.8	2.5	9.4	10.6	6.4
Diagnosing Indiv or Org	5.9	3.8	6.2	10.8	3.2	6.0
Initiative/tenacity	5.8	9.6	0.0	6.5	7.4	5.9
Communication	5.9	5.8	3.8	6.2	7.4	5.8
Knowledge of Elem Curric	3.4	6.7	3.8	4.0	6.4	4.9
Master Teacher	2.9	3.8	5.0	3.5	6.4	4.3
Demonstration/Modeling	2.2	1.9	0.0	8.3	4.3	3.3
Trust/Rapport Building	3.4	5.8	0.0	5.6	0.0	3.0
Managing/Controlling	4.0	1.0	1.2	3.0	2.1	2.3
Group Functioning	1.6	0.0	0.0	8.1	1.1	2.1
Confidence-Building	2.2	1.0	1.2	5.1	0.0	1.9
Independence-Building	2.0	0.0	3.8	*	0.0	1.1
Use of Humor	.5	1.9	0.0	*	0.0	.5
Confrontation	.7	0.0	0.0	0.0	0.0	.1
Conflict Mediation	.4	0.0	0.0	0.0	0.0	.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

* Skill was not included on questionnaire.

Rather, coordinators need a solid command of microcomputer operations including basic care and maintenance, saving and printing files, using peripherals, and general troubleshooting. In addition, effective coordinators possess a broad knowledge of software, including how to troubleshoot when problems arise with particular programs. While coordinators emphasize to teachers that they "don't have all the answers," it appears critical that they have the knowledge to help solve most technical problems and minimize undue stress. Sometimes, learning to use computers can be extremely frustrating--enough to induce some people to avoid further use. In such cases, simple technical help can be far more effective than hours of well-intentioned nurturing and support. Teachers, as learners, need to feel successful, and technical expertise can often contribute to such success.

When compared with Tom and Sue, it seems clear that Karen's deficiencies in this area hampered her effectiveness. One teacher stated that a computer coordinator should be able to:

> diagnose a problem instantly, rather than by trial and error, [and] know exactly what to do to get the kid back on track....Most of us don't have that expertise, and I want someone who does....[Karen] herself will admit that she's not an expert. In other words, it's trial and error for her when the program won't run for some reason. Why it's "guess and by golly for her too.

While it seems unreasonable to expect coordinators to "instantly diagnose" all problems, a coordinator loses credibility if he or she frequently has difficulty in troubleshooting. Consistent with previous research on change agents (Beaton, 1985; Miles et al., 1986a; Rogers, 1983), knowledge, competence, and experience are critical for change agents to establish credibility. Interestingly, over 21 percent of the critical incidents cited (incidents when coordinators were especially helpful to teachers) involved coordinators' use of technical expertise. Also significant is the fact that technical expertise comprised over 23 percent of recommendations for the selection of coordinators, further confirmation of the importance of this skill.

Technical expertise also appears important because of the developing nature of the innovation. Coordinators must keep abreast of advances in hardware and software and facilitate decisions concerning how these advances might enhance the achievement of curricular goals. In the case of computers in education, the innovation is difficult to tie into a "neat curriculum package." The field is changing rapidly and will continue to do so. Computer coordinators therefore must have the technical expertise to keep up with these changes.

Interpersonal Skills, which include support, collaboration, interpersonal ease, communication, and trust and rapport building, are clearly critical for change agents to establish and maintain positive working relationships with teachers. This finding is consistent across the three cases, as well as with previous research on change agent activities.

The coordinators also need interpersonal skills to reduce the discomfort of a threatening learning situation for teachers. The fact remains that while computer expertise is desirable for elementary teachers, it is not yet a fundamental skill. The current payoff in terms of opportunities for student learning does not warrant mandating computer use where teacher commitment is not in place. It makes better sense to provide opportunities for teachers and encourage their participation. To carry out this strategy, interpersonal skills are clearly needed to facilitate teacher involvement and promote commitment.

Balance of Skills. Apart from the mere possession of the necessary skills, coordinators need a delicate sense of timing and balance in their use. Though it involves a difficult balance, effective coordinators seem to combine being patient and "low key" with being active and systematic. As Beaton (1985) suggested for staff development specialists, coordinators must balance process-oriented interpersonal skills with task-oriented training and organizational skills.

One difficult balance to achieve involves the inevitable conflict between overcoming teacher resistance to computers and facilitating teacher independence. Basically, the more a coordinator does to make things easy for teachers (e.g., choosing materials, planning lessons, teaching the lessons, always being there to "bail people out," etc;), the less stress and resistance there tends to be. On the other hand, the more a coordinator provides such help, the more the teachers tend to be dependent on that "helping hand."

John alluded to this conflict in a parable that contrasted the approaches of Tom and Sue:

> It's like you have two nests of little birds. And in the one nest the daddy bird [referring to Tom] says, "Don't worry, I'll fly you forever. I'll take you anywhere we need to go, and I'll do a nice job of it. And you'll love me." And they do. And he does [a nice job]. And in the other nest, the mommy bird [referring to Sue] says, "I'm going to teach you to fly. And you're going to fall on your butts at times. And other times you won't. And it's going to be fun, and crazy, and overtaxing. And you've got to trust me. But someday you'll be able to fly, and if I'm not around anymore, it won't matter much."

Thus, the question arises regarding how helpful to be. While John clearly endorses the second strategy, it may not work with all teachers in all settings. Ambitious plans for getting teachers to independently fly on their own" can result in increased teacher competence. It may also create, however, greater teacher resistance. Tom insists that a developed curriculum and framework for implementation needs to be in place before teachers at East should be expected to commit themselves to a computer-based curriculum. Meanwhile, his approach is to gradually draw teachers in. In any event, effective coordinators judiciously analyze and diagnose individuals and organizations. They consider the comfort level and commitment of the individual staff members and the school as a whole in choosing a preferred timeline and approach for computer implementation.

4. What are the intended and actual accomplishments resulting from the computer coordinators's work?

Table 2 shows the most frequently cited outcomes in the present study. The second column lists the frequency that particular outcomes were mentioned, and the third column shows the percentage of the total outcomes that particular outcomes were mentioned (e.g., for capacity building 26/152 = 17.1%). The fourth column lists the weighted rankings from the questionnaires given to coordinators and supervisors. (See the explanation of the weighted rankings for skills in Table 1.) The fifth column shows the percentage for these rankings. The last column displays the average of the two percentages (from the third and fifth columns). Outcomes are arranged by the Total Average, from highest to lowest.

In each case, informants reported capacity-building, which is improvement in the capability or skills of teachers, as a prominent outcome. Other high ranking outcomes include implementation of the program and client satisfaction with the program. Also, the programs clearly had impact on the students regarding their comfort and confidence in operating computers. Interestingly, student impact ranked as the second most noteworthy outcome, according to the frequency of mention. Coordinators and supervisors, however, did not rate this outcome high on their questionnaires. One explanation for this difference might be that the coordinators and supervisors placed a higher priority on the training of teachers. Also, they might have regarded student impact as pertaining to gains in academic skills, and therefore did not consider increased "computer literacy" as part of this outcome. Also, they might have sensed that the present study was focusing on teachers as the primary clients of the coordinators.

Table 2. Frequency and Percentage of Outcomes Effected by Computer Coordinators

Outcomes	Frequency Mention	Percent Mention	Quest. Ranking	Percent Ranking	Total Average
Capacity Building	26	17.1%	56	29.3%	23.2%
Implementation of Program	36	23.7%	40	20.9%	22.3%
Satisfaction with Program	25	16.4%	26	13.6%	15.0%
Student Impact	28	18.4%	7	3.7%	11.0%
Use of Specific Products	11	7.2%	19	9.9%	8.6%
School Climate Change	9	5.9%	12	6.3%	6.1%
Organizational Change	12	7.9%	8	4.2%	6.0%
Institutionalization	3	2.0%	12	6.3%	4.1%
Short-Run Success	2	1.3%	6	3.1%	2.2%
Positive Relationships	0	0.0%	5	2.6%	1.3%
Total	152	100.0%	191	100.0%	100.0%

DISCUSSION

Integration: Is It Worth It?

Most educators recognize a clear trend toward greater computer use in schools (Reed & Sauter, 1987). Furthermore, most would predict that computers will one day become an everyday tool in all aspects of the curriculum. The question then becomes how to implement this innovation, and on what timeline. It seems clear that computer education in the schools can be most efficiently implemented at present through specialized classes taught by qualified computer teachers. Such an approach requires minor curriculum reform and minimal teacher training. In a sense, though, this implementation strategy is a "quick fix." While it addresses the immediate computer literacy needs of students, it does little to bring the majority of teachers, as well as school programs in general, into the information age.

Proponents of computer integration foresee a gradual transition toward using computers in all aspects of the curriculum. They stress the need for teacher training and curriculum reform. While this approach involves a significantly greater change than does computer specialization, the long-term payoff appears far greater. School districts, then, must establish priorities regarding computer implementation. District administrators should consider both the costs and benefits of computer integration and plan accordingly.

Impediments in Perspective: The Need for Teacher Commitment

In the Rand Change Agent Study, Berman and McLaughlin (1977) found that teacher commitment to an innovation has the most consistently positive relationship with project outcomes. The authors explained that project success is unlikely unless teachers want to work hard to make it happen. Factors that lead to teacher commitment include the innovation's quality, need, and clarity (Fullan, 1982).

In the current case of integrating computers into the curriculum, all of these factors have been questioned. Teachers agree that computer-based applications are improving, but the quality of many programs and their "fit" into the curriculum still leave much to be desired. While the need for increased computer use throughout the curriculum is well supported for schools of the future (Moursund, 1986; Reed and Sauter, 1987), the immediate need is not quite so clear. Also, while the Eugene District has provided a framework for integrating computers (i.e., the district curriculum strands), and has made steps to clarify the goals and means of implementation, the large goal of integration is still perceived by some as undeveloped and "fuzzy."

Overall, many teachers are not yet convinced that the current implementation of computer applications can effect a significant difference in student learning. Nor are many teachers convinced that computer education should be the top priority in their program for professional growth and school improvement. Most teachers, however, do recognize the need for teachers and students alike to begin making the transition toward more meaningful use of computers in schools.

The Eugene district provides a framework for such a transition. It stipulates that all elementary teachers should be trained and able to integrate computers into the curriculum. As stated, however, there are a great many impediments to implementing such a plan. The strategies used by effective coordinators to overcome these impediments, then, are critical for program success. A discussion of such strategies follows.

Effectiveness of Larger Strategy of Using Computer Coordinators

Most teachers today have jumped on the computer bandwagon to some degree. Only the most resistant teachers have managed not to take part in some of the inservice offerings available. Such workshops, however, appear to be "loosely coupled" to subsequent practice. Little follow-up occurs and only a small percentage of teachers are able to effectively transfer into classroom practice what they have learned in workshops and university classes.

Another approach to integrating computers in education might involve the centralized research and development of major curriculum reform. This strategy would clearly help provide a framework for implementing a computer-based curriculum. Such centralized efforts and "teacher proof" curriculum projects, however, are currently not highly regarded. While some excellent materials have been developed, most have not been effectively implemented at the school level.

A current trend in school improvement focuses on school-based change rather than centralized curriculum reform. Consistent with this trend, computer coordinators serve as on-site staff developers and help mold the innovation to "fit" a school's educational program. In addition to dealing with curriculum issues, coordinators provide a variety of training and support functions that lead to implementation of computers in their schools. Therefore, the "game plan" of hiring computer coordinators appears to be a very good one. Although the plan is costly, it seems to hold true that "you get what you pay for." Effective coordinators can bring about significant changes at the school level.

Suggested Guidelines for Implementation of Coordinator Role

Time Needed. Two elements of time required must be considered: the full-time equivalent (FTE) allotted for the position, and the number of years projected for the appointment. It appears that a .5 FTE is adequate for coordinators in medium to large-sized elementary schools. If less time is allocated, role expectations should be adjusted. As was clearly illustrated in one of the case studies, ambitious plans and limited time for implementation leads to frustration.

Supervisors and coordinators stated that coordinators should be allocated a minimum of two to three years to perform their role. Of course, this recommendation is dependent upon the extent of the school's goals regarding computer use. The concurrent goals of teacher independence and computer integration involve significant changes in practice, and therefore require much time to accomplish.

As was learned in all of the cases, it is difficult for a coordinator to "work herself out of a job." Tom, in the conclusion of his second year in his role, has made much progress in establishing a framework for computer use and getting teachers comfortable with computers. Teachers at East, however, were far from being independent of his services. Teachers at Central appeared to be further along toward independence. After implementing an ambitious program with teachers in her first year as released coordinator, Sue had hoped to be able to phase out her job after one more year (by the end of the 1986-87 school year). While Sue recognized that this goal was possible, she did expect that teachers would continue to need support in organizing the lab, selecting software, and keeping abreast of advances in the field.

One possible way to phase out reliance on a coordinator might be to use a "multiplier mode" to spread the innovation. This strategy consists of asking teachers to lead workshops, demonstrate their work to others, act as mentors, serve as a cadre, and begin to act like teacher specialists (Miles et al., 1986b). While such an approach may not eliminate the need for a coordinator, it may help decrease the needed FTE for the role.

Need for Long-term Planning. Each school examined in the present study demonstrated a commitment to computer education in staffing the coordinator position. The role of the coordinator, however, is but one factor of many that needs to be considered in establishing a long-term building plan. If the school's plan involves integration on a large scale, it appears critical that teachers assume ownership of the plan and commit themselves to carrying it out. Coordinators can facilitate teacher ownership and commitment by working through the school's computer committee. Sue's work at Central attests to the effectiveness of this strategy. The computer committee appears to be a critical component of establishing and implementing a long-term plan for computer use.

Selection and Training of Coordinators. Prospective coordinators should possess a good balance of technical, interpersonal, and organizational skills. "People skills" appear to be more difficult to teach and learn, and therefore people chosen as coordinators should already be strong in such skills.

It appears to be an advantage to choose coordinators from the school's existing staff. With trust and rapport already in place, the coordinator can "move the program along" at a more accelerated pace than could an "out of staff" person. Out-of-staff coordinators, therefore, have a greater need for strong interpersonal skills in order to work effectively with new colleagues.

Training should be considered to facilitate coordinator effectiveness. While coordinators would benefit from participating in a general forum in which they can share concerns, training sessions for targeted needs would also be helpful. As Miles and his colleagues (1986b) recommended for change agents in their study, computer coordinators would benefit from training in organizational change. Such training might involve specific strategies and skills in working with the school as an organization, including strategies for working with computer committees and parent volunteer programs. Other topics for training might involve issues and techniques related to current hardware and software.

Implications for Educational Policy Makers

Computer education has been a much publicized, high profile innovation. It is estimated that in the spring of 1987, there were close to two million computers in elementary and secondary schools across the country. Consistent with other innovations, however, inadequate funds have been allocated to support the implementation of computers in schools. Teachers have not been adequately trained, and computer-based curricula are still in their infancy.

The present study illustrates how difficult it is to effect significant educational change. It involved three schools that have been active in implementing and expanding computer use. Yet there are many impediments to full-scale implementation of this innovation. Computer coordinators use a variety of strategies and skills to help overcome these impediments in order to effect meaningful change. It appears that without the implementation support that coordinators provide, instructional computer use is unlikely to fulfill its promise as an educational innovation.

The findings of this study are consistent with the findings of other studies on educational change. The present study supports the effectiveness of staffing change agents to work with teachers at the school level.

Limitations of the Study

Five limitations of the present study seem noteworthy. The first limitation of the study was the small size of the sample examined. The present study examined the work of three computer coordinators in elementary schools in one school district. Therefore, the present findings are not readily generalizable to other coordinators working at various school settings in different locations.

The second limitation was the nature of the sample. To discover effective coordinator behaviors, the present study examined coordinators in schools where a high degree of implementation was reported. Thus the present sample lacked the inclusion of ineffective coordinators with which to contrast effective skills, strategies, and outcomes.

The third limitation was the method of data collection. Data were gathered primarily by interviewing teachers, coordinators, supervisors, and parents involved in each school's program. While relevant documents were examined and classroom observations conducted, a majority of the data were based on informants' perceptions of the program. Implementation effects (e.g., improved computer skills of teachers and students), for example, were based on informants' perceptions of such effects rather than on the use of measures involving direct observation.

The fourth limitation was the lack of precision in the coding system used to measure strategies, skills, and outcomes. Multiple codes can often apply to many of the effective behaviors and outcomes. For example, in helping a teacher who "gets stuck" using a particular program, the coordinator might use a combination of skills including: providing support, trust and rapport-

building, confidence-building, independence-building, communication, diagnosing individuals, and interpersonal ease. Therefore, it was necessary to create addenda to the coding system in order to increase coding reliability. The fact remains, however, that many actions do involve multiple codes. The codes given in the present study, therefore, represent a systematic approximation of the variables being examined.

The fifth limitation was the method of data analysis used in the present study. While steps were taken to establish inter-rater reliability, the fact remains that the author individually selected what interview data to transcribe. Further, after the data was coded, the author chose what "chunks" of data to use in the text of this report. While various steps were taken to increase the validity of the findings (e.g., using multiple measures, cross-checking findings across multiple sources, having informants read drafts of the cases to check for accuracy), the method of data analysis and reporting was reliant on the interpretations of the author.

Recommendations for Further Study

Results and limitations of the present study suggest six directions for future research:

1. The present study yielded rich descriptions of the work of elementary school-based computer coordinators in one district. The study should be replicated and extended at different settings, including at middle school and high school programs. In addition, larger samples might be used to increase the generalizability of the findings.

2. Much can be learned from comparing and contrasting effective coordinators and programs with less effective coordinators and programs. Such a comparison would help to further identify effective strategies and skills needed by computer coordinators. In addition, by studying less effective programs, we can learn more about the impediments to computer integration and strategies that might be used to overcome such impediments.

3. Further studies of change agent behaviors should use measures involving direct observation of implementation effects rather than continuing to rely on informants' perceptions of such effects. The addition of observation measures would increase the validity of future studies and enable more valid comparisons of findings across cases and studies.

4. We need to examine the cost-effectiveness of the school-based coordinator model. How does the effectiveness of this approach compare to other approaches such as the allocation of funds for the research and development of a computer-based curriculum, or a more traditional inservice model?

5. While the coding system used in the present study offers a valuable framework from which to examine coordinators' work, it is somewhat "clumsy" in the amount of overlap that exists in like skills and strategies. A more streamlined coding system, perhaps made up of clusters of strategies or skills, would facilitate easier comparisons and clearer reporting of findings.

6. The present study suggests that computer coordinators can increase their effectiveness by participating in training that involves particular strategies and skills. Therefore, training modules should be developed, implemented, and evaluated with coordinators. Such modules might include strategies for: (1) organizational change (including working with school computer committees), (2) overcoming teacher resistance and building teacher independence, (3)resource-adding (e.g., grant writing), (4) working with parent volunteers, and (5) implementing a computer-based curriculum.

APPENDIX A: Variables Used in the Study

Strategies Used by Change Agents

A strategy is defined as a carefully planned method of translating theory and assumptions into action in order to achieve a goal. A total of 15 strategies were used to categorize the approaches employed by the coordinators. The list was based on the system developed by Miles (1984) and modified by Beaton (1985). They were defined as follows:

Providing technical assistance: helping individuals develop competence in specific techniques.

Resource-linking: a dissemination process that involves transmitting ideas from outside researchers and trainers and building them into a teacher's repertoire of skills through on-going training; or introducing clients with needs to resource people.

Solution-giving: providing innovation or other products of research as solutions to the perceived needs of others; often initiated without negotiation.

Training of groups: running workshops and courses to teach understandings and skills.

Coaching of individuals: training and teaching 1-1 using clinical observation and conferences in the teacher's classroom.

Organizing, preparing: planning, researching, and preparing for the operation of the computer program.

Demonstrating, modeling: demonstrating skills or techniques to assist understanding and to serve as a model for the learners to copy.

Energizing, motivating: initiating awareness and involvement; building confidence and a willingness to improve; establishing a rationale for the techniques being taught.

Supporting the client emotionally: relaxing tension and dispelling fear; reassuring and stressing positives with sensitivity and empathy; stroking of client.

Developing a support structure: creating a network or procedure for the support of clients, involving their teaching peers, their supervisors, or both. Creates a mechanism for support.

Supported planning: assisting clients through the planning process.

Collaborative problem solving: shared involvement with clients in the problem-solving process.

Resource-adding: supplying materials and ideas to clients.

Monitoring, evaluating: judging the effectiveness of a teacher's performance in order to stimulate change.

Controlling client action: exercise of power, albeit expert power used with client consent, to direct the actions of clients.

Skills Use by Change Agents

Skills are defined as requisite knowledge or ability, or special qualifications to perform the tasks involved in the role. The focus in analyzing the data is on attributes and capabilities of the change agent expressed with a qualitative description by informants; e.g., the trainer does this well (or poorly). Skills can be seen as generic tools, and thus may be applicable in many different strategies.

The classification of skills is based on the revised system of Miles and colleagues (1986a). They subdivided the skills into general skills and specific skills. The 21 skills used in this study are defined (in abbreviated form) as follows:

General Skills

Interpersonal ease: relating simply and directly to others.

Communication: ability to listen, talk, and write.

Group functioning: understanding group dynamics, able to facilitate team work.

Training/doing workshops: direct instruction, teaching adults in a systematic way.

Master Teacher: wide educational experience, able to impart skills to others.

Knowledge of elementary curriculum: knowledge of elementary school subject matter.

Technical expertise in educational computing: knowledge of hardware and software involved in instructional computing

Administrative/organizational: defining and structuring work, activities, time.

Specific Skills

Initiative-taking/tenacity: starting or pushing activities, moving directly toward action.

Resource-bringing: locating and providing information, materials, practices, equipment useful to clients.

Trust/rapport-building: developing a sense of safety, openness, reduced threat on part of clients; good relationship-building.

Support: providing nurturant relationship.

Confidence-building: strengthening client's sense of efficacy.

Confrontation: direct expression of negative information without generating negative affect.

Conflict mediation: resolving or improving situations where multiple incompatible interests are in play.

Collaboration: creating relationships where influence is mutually shared toward decisions regarding the program.

Humor: Use of humor to aid work with clients.

Diagnosing individuals/organizations: forming a valid picture of the needs/ problems of an individual client or a school as an organization.

Managing/controlling: orchestrating the improvement process; coordinating activities, time and people; direct influence on others.

Demonstration: modeling new behavior in classrooms or meetings.

Independence-building: Getting people to do it themselves.

Outcomes of the Change Agent Activities

Outcomes in this study are considered to be any effect on teachers, students, administrators, or schools that results from the interventions of the change agents. The outcomes, based on the classification of Miles (1984), form a hierarchy in that outcomes that come later on the list are considered more difficult to attain. If two or more codes applied to a particular incident being coded, precedence was given to the highest outcome in the hierarchy.

Abbreviated definitions of the ten outcomes follow:

Short run success: small achievements made that enable other achievements.

Use of specific products: teachers use products or materials that they hadn't previously used.

Positive relationships: client satisfaction with positive relationship with the change agent.

Satisfaction with the program: positive attitudes of individual teachers and administrators toward the program.

Implementation of program: the extent to which the formal program is being carried out.

School climate change: feelings, norms, or sentiments have changed.

Organizational change: changes in the structure or procedures of the school.

Student impact: students have a favorable attitude to the new teaching method, or have changed behavior in some way, or have changed in achievement.

Capacity building: improved capability or skills of teachers.

Institutionalization: program features, structures, and procedures are built into the school.

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